REVIEW OF GROUND-WATER HYDROLOGY

WHITE RIVER SHALE PROJECT

Tracts Ua and Ub, Utah

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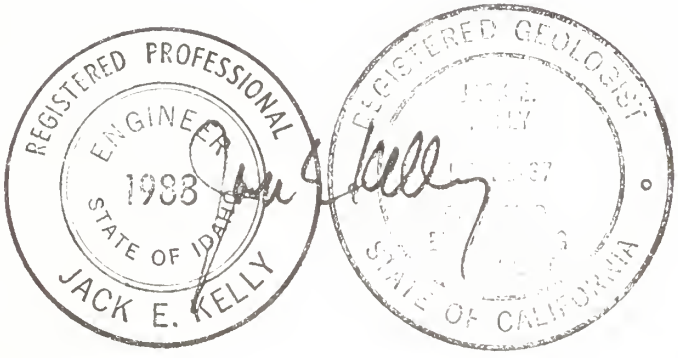
Prepared for

White River Shale Project

Salt Lake City, Utah



May 1976

REVIEW OF GROUND-WATER HYDROLOGY

WHITE RIVER SHALE PROJECT

General

Development of the oil shale resources of Tracts Ua and Ub by the White River Shale Project (WRSP) will entail underground mining and disposal of spent shale. Both of these activities could have an effect on ground water if precautionary measures were not taken before and during development. Environmental baseline studies by VTN, environmental consultants for the project, included extensive surface and ground-water studies and data collection to establish existing conditions. That information was used to prepare applicable portions of the Detailed Development Plan (DDP) submitted to the Area Oil Shale Office.

The purpose of the review by Anderson & Kelly was to provide an independent evaluation of the ground-water data and to achieve agreement in principle on those sections of the DDP that might constitute an effect on or by ground water, before final submittal of the DDP. Evaluation of the ground-water data is summarized herein; previous conferences and correspondence with Bechtel and WRSP personnel achieved the agreement in principle of those applicable sections of the DDP.

The review and the evaluation of the DDP, with respect to ground water was based on three major considerations. These included:

1. The potential impact of underground mining on the ground-water regime.

2. The potential for contamination of any existing ground-water resources by leachate from spent shale or seepage from ponds constructed for project use.

3. Proposed or potential ground-water use by the project during Phase II, before construction of the surface water reservoir on the White River.

Data review was supplemented by a field trip to the area April 20-21, 1976.

Initial Data Review

A preliminary review was made of applicable VTN data and an early draft of the DDP in San Francisco on February 23, 1976 and additional, more detailed, study was made in Boise prior to another meeting on March 2, 1976 in San Francisco. At that time, all available information had been reviewed and discussed. Available data included the ground-water sections of VTN quarterly reports, Bechtel data prepared for inclusion in the DDP, and the draft of the DDP sections. The summary information prepared by Bechtel-Geology was discussed by telephone and reviewed on March 2 with appropriate personnel. Based on the review of all available data and the discussions, basic agreement on the proposed revisions of the draft of DDP Sections 3, 4, 5, 6 and 7 was reached. Subsequent to the March 2 meeting, additional data was received from VTN and Bechtel for final review and study, including the final draft of the DDP.

The discussions and conclusions presented below are based on the final draft of the DDP, VTN reports mentioned herein, and the field trip to the area.

Potential Impact of Mining

Removal of the oil shale zone by mining will have some structural effects on the overlying strata. These physical changes, such as tension fractures, are expected to be minor on an overall basis but probably can be observed, or measured, locally. Theoretically, these fractures could increase vertical permeability between the bird's nest zone and the mined zone. Field observations in Hells Hole Canyon of the thick shaly section intervening indicate ground-water communication between the two zones is unlikely. Furthermore, if tension fractures occur, they would not extend through the entire section in sufficient magnitude to cause a significant increase in the overall vertical or horizontal permeability. Locally the theoretical permeability could be increased but, inasmuch as the mined zone is expected to be essentially "dry", this condition will have no effect on ground water.

Any surface expression of subsidence resulting from mining is expected to be minimal and relatively uniform, on an areal basis. However, because it could occur, the magnitude should be known. It is understood that a re-survey of USGS survey markers in the project area was made during the baseline data collection program. These data, compared to previous surveys apparently show no subsidence or uplift has occurred in the last 40 years, according to verbal communications originating from VTN personnel. An on-going program of elevation monitoring during the life of the project, as presented in the DDP, appears advisable.

In the VTN reports, the bird's nest zone has been called the only significant aquifer that could be affected by the project. However, this zone has been shown by exploratory drilling and testing to be inconsistent with respect to permeability, porosity and quality of contained water. Furthermore, although it is an "aquifer" by definition, some aspects of the water quality render it unusable for many uses. Consequently, in some respects, it is no more an "aquifer" than some connate water bearing zones in oil fields.

Ground water in the White River alluvium and the limited alluvial fill in Evacuation Creek and Southam Canyon will not be effected by the actual mining activities. Mine shaft sinking could have some measurable effects on the water levels in the bird's nest zone in the vicinity of mine shaft locations. However, if this zone is adequately sealed off, as planned in the DDP, effects will be short lived. Provisions to measure water levels have been made in the monitoring program of the DDP so that future comparisons to baseline data are possible. Exploratory drilling at the mine shaft and geotechnical studies, planned for the Initial Mine Access-Phase I, will provide additional information on the bird's nest zone in that area. In any event, any effects on water levels in the bird's nest zone would simply be a slight decline or depression in the potentiometric surface. Mine dewatering in the Mahogany zone is not expected to effect water levels in the bird's nest zone because of the thick shaly section intervening, as mentioned earlier. However, even if some hydraulic interconnection was established, only local water level changes would occur.

Mining activities will not have any effect on the quality of water in the various zones discussed above. This is because the hydrologic changes, however minimal, would result in flow from these zones not flow into them.

Potential Impact of Seepage

The processed, or spent, shale will be deposited in Southam Canyon. Retention dams, planned for both the initial and subsequent large-scale phases of retorting, will be adequate to control any runoff from the processed shale. Surface contouring to retain precipitation also will deter direct runoff from the processed shale area. Furthermore, the region is characterized by extremely low precipitation that is barely adequate to support the sparse native vegetation.

WHITE RIVER SHALE PROJECT

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July 20, 1976

Mr. Peter A. Rutledge
Area Oil Shale Supervisor
U. S. Geological Survey
131 North 6th - Suite 300
Grand Junction, CO 81501

Dear Mr. Rutledge:

Subject: Ground Water Report
Tracts Ua-Ub

Confirming our conversation of July 19, enclosed are three copies of Anderson & Kelly's "Review of Ground Water Hydrology, White River Shale Project," dated May, 1976.

Sincerely,

C. E. Doney
Manager, Engineering

CED/fb

Enclosures

Revegetation programs on the processed shale will insure that precipitation will, for the most part, be utilized by plants as evapotranspiration. Consequently, infiltration of precipitation below the root zone will be minimal. The moisture content of the processed shale during placement will be less than the field capacity. Therefore, any water that passes the root zone will be "absorbed", so to speak, before it can move to the toe of the slope. It is considered most unlikely that any seepage from the processed shale disposal areas will even occur.

As previously mentioned, retention dams will contain runoff from the spent shale. Potential seepage from the dams and/or waste water holding basins can be controlled by standard design features, such as cutoff trenches under the embankments. A large retention dam is planned for the north end of Southam Canyon in the Commercial Operation Phase. Inasmuch as the region is characterized by low precipitation and the drainage area is limited, it is doubtful that sufficient runoff will be impounded to provide a source of seepage. Furthermore, the high evaporation rates indicate that the "reservoir" probably will be dry at the beginning of winter each year.

This large dam will be constructed on the nearly horizontal Unita formation. Numerous examples of cross bedding were observed and, overall, horizontal permeability does not appear to be a potential problem. Field observation of outcrops reveal a vertical jointing pattern. However, in many cases, the joints do not appear continuous. Exploration drilling of the site will determine if this jointing system is open sufficiently to allow abutment seepage. In any event, grouting and/or interception drains can control any potential seepage.

Even if some seepage occurred, no contamination of ground water would occur. In Phase II any seepage from the single retort catchment would enter the alluvium of Southam Canyon, which is not an aquifer. In the lower reaches of Southam Canyon the alluvium is thin, with little or no storage and/or transmitting capacity. At one point, an outcrop of the Unita formation was observed in the dry stream bed. At that locality there is virtually no alluvium. Any seepage could not reach the White River.

In the subsequent Commercial Operation Phase, the large runoff retention dam is further downstream, near the mouth of Southam Canyon. If seepage occurred there, it would enter the alluvium and, at least theoretically, eventually reach the White River. The design criteria for drainage control should include provisions to prevent and/or capture seepage, such as grout curtains and interceptor drains. However, monitoring wells into the near surface materials in the immediate vicinity also are advisable. Periodic observation and water sampling of these wells would provide an early warning system to detect any seepage that might occur. This would allow ample time to intercept any seepage, as required. Wells, or sampling points, of this type probably should be considered a design feature and not part of the DDP. The final determination of their number, location and depths can be made during exploration for design.

Any seepage from the processed shale areas could not contaminate the ground water in the bird's nest zone. Exploration drilling indicated that zones above the bird's nest are not saturated. Consequently, any seepage from the

processed shale would go into "storage" rather than percolate further. However, even if deep percolation occurred, the water could not reach the bird's nest zone. It is overlain by confining beds of very low permeability, as evidenced by the artesian conditions in the western part of the area. Furthermore, the lower zone in the bird's nest, which had a large water yield during testing of P-2, is separate from the upper zone. Their static water levels differ by about 50 feet and the upper zone was not affected during pumping of the lower zone.

Ground Water Use in Phase II

The initial development phase of the project calls for use of ground water from the alluvium of the White River in the NE¼ NW¼ Sec. 14, T 10 S, R 24 E. This 40-acre tract does not include a significant area of river channel but it is understood that the adjacent NW¼ NW¼ may be available for project use. That tract contains more area for a well field in the alluvium.

The ground-water requirement has been estimated to be about 200 gpm. That amount can be developed by shallow wells drilled into the alluvium but their number and location cannot be determined without some exploratory work.

Conclusions

1. The White River Shale Project Detailed Development Plan, as submitted to the office of the Area Oil Shale Supervisor, makes adequate provisions to protect, monitor and conserve the existing ground-water resources of the area.

2. The impact of underground mining on the bird's nest zone and alluvial ground water zones is expected to be non-existent or, at the most, minimal.

3. No contamination of any existing ground-water resources by processed shale leachate is expected. The potential for adverse impact will be eliminated by the various design features and the monitoring program to be incorporated in the various structures and/or operations.

4. The limited ground-water supplies required for the initial development phase (Phase II) of the project can be obtained from wells drilled into the White River alluvium. A determination of the location and number of wells needed will require field investigations that may include some exploration drilling.

Form 1279–3
(June 1984)

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